Crane Point Project

Fire Fuels Air Quality Appendix

Information listed below describes the methodology used to calculate predicted fire behavior pre and post treatment.

The information used in this analysis is a combination of available data, research material, literature, field reviews, modeling, and assessments. A fuels field review of the area was conducted in 2017 and 2018. This review consisted of visiting proposed non-commercial units and some stands in the project area, performing walkthrough exams, and making recommendations for appropriate treatments based on observed stand conditions, in cooperation with silviculture. Database queries of Fire Regimes, Fire Regime Condition Class, Burn Severity Codes, Landfire, Benewah County Wildland-Urban Interface Wildfire Mitigation Plan 2012, Latah County Multi-Hazard Mitigation Plan 2011, Latah County All Hazards Mitigation Plan 2007, Behave Plus 6.0.0, and Wildland Fire Assessment Tool were also used to assess the burn severity, current and historic fire regimes of the project area.

Fuel Models were determined based on field reviews and *Aids to Determining Fuel Models for Estimating Fire Behavior* (Anderson, 1982). Anderson classified fuels into four groups based on the observed and expected fire behavior; grass, brush, timber, and slash. BEHAVE Plus 6.0.0 (firemodels.org), a fire behavior prediction and fuel modeling program, was used to predict fire behavior given current conditions and post-treatment conditions.

Wildland Fire Assessment Tool was used to determine the Burn Severity Classification. The Wildland Fire Assessment Tool (WFAT) is a custom ArcMap toolbar that provides an interface between ArcGIS desktop software, FlamMap4 algorithms (Finney 2006), First Order Fire Effects Model (FOFEM) algorithms (Reinhardt 2003), and FuelCalc (Reinhardt and others 2006) algorithms to produce predicted fire behavior, fire effects, and post-fire fuels map layers. WFAT is the successor to the Fire Behavior Assessment Tool (FBAT; Hamilton and others 2007) and the Fire Order Fire Effects Model Mapping Tool (FOFEMMT; Hamilton and others 2009) and incorporates the functionality of both tools into one software application.

Fuel Models

Historically, most healthy, mature, closed-canopy timbered sites were best represented by Fuel Model 8. On some inclusions where that canopy was more open, and in young stands, Fuel Model 5 with young, vigorous trees/shrubs models fire behavior best. Within the Crane Point project area, existing fuel loads in mature untreated stands are moderate to heavy and are best characterized by Fuel Model 10, with inclusions of light ground fuels best characterized by Fuel Model 8 and a dry-5. Within plantations the fuel loading is best characterized by a Fuel Model 5. Most of the fuels on National Forest System lands are naturally occurring.

Fuel Model 8 (Timber Group): This model exhibits "slow-burning ground fire, generally with low flame lengths, although the fire may encounter jackpots of fuel that will flare up. Only under severe weather conditions involving high temperatures, low humidity, and high winds do the fuels pose fire hazards. Closed canopy stands of short-needled conifers support fire in the litter layer. This layer is mainly needles, leaves, and occasionally twigs because little undergrowth is present in the stand". (Anderson, 1982)

Fuel Model 10 (Timber Group): "Fires burn in the surface and ground fuels with greater intensity than in other timber models. Dead-down fuels include greater quantities of 3-inch or larger limbwood resulting from overmaturity or natural events that create a large load of dead material on the forest floor. Crowning out, spotting, and torching of individual trees are more frequent in this fuel situation, leading to potential fire control difficulties. Any forest type may be considered if heavy down material is present; examples are insect- or disease- ridden stands, windthrown stands, or overmature situations with deadfall" (Anderson, 1982).

Fuel Model 5 (Shrub Group): This model is used for plantations because the young, vigorous trees tend to carry fire in the way that live, healthy brush does. "Fire is generally carried in the surface fuels that are made up of litter cast by the shrubs and grasses or forbs in the understory. The fires are generally not very intense because surface fuel loads are light, the trees/shrubs are young with little dead material, and the foliage contains very little volatile material" (Anderson 1982). This model has a live fuel component, which for plantations, will be high due to their vigor.

Dry Fuel Model 5: The model here is the same as described above, but would be used in dry inclusions such as where instead of a young, vigorous shrub layer, there is a tall and decadent shrub layer with large amounts of needle-drape on those shrubs. Fire behavior in the increased ladder fuels is best modeled with this fuel model, although the live fuel moisture is severely reduced. This model then demonstrates the increase in fire behavior observed in these settings.

BEHAVE Outputs modeled here are:

- (ROS) Rate of Spread (chains/hour): Given a particular slope and windspeed, how fast will a point-source fire spread in this Fuel Model?
- (FL) Flame Length(feet): Given a particular slope and windspeed, what would the average flame length be? Flame length is an indicator of fireline intensity, or heat. The intensity of the heat dictates what suppression tactics may be employed. Fires with FL<4' can be safely attacked by handcrews using direct tactics. Fires with FL<8' can be safely attacked with machinery suing direct tactics. Where FL>8', direct tactics cannot be used, and fires must be attacked using indirect tactics.
- Estimated Fire Size (acres) given a 2-hour lapse time from the start of the fire: Given the same parameters, how big would this fire be two hours post-ignition, when firefighters could be expected to arrive on-scene?

The BEHAVE Plus Model has the following assumptions and limitations:

- The models deal only with surface fuels within 6 feet of the ground.

- "Live Fuel Moisture", the foliage and fine stems of living plants are considered fuels, and dampen the rate of spread (heat sink) when moisture content is high, and increases (available fuel) as moisture content drops.
- Fire spread by spotting, crowning, or through fire whirls is not part of the output.
- Fuels are continuous as in the arrangement (spatially across the landscape) of those fuels.
- Slope, wind speed, and wind direction are constant.

Pre-treatment

The table below displays the inputs to the BEHAVE model used to model potential fire behavior based on existing stand conditions, including Fuel Models 5 and 10.

Table 3: Inputs for BEHAVE model for existing conditions

1-Hr Fuel Moisture	6.0 %
10-Hr Fuel Moisture	7.0 %
100-Hr Fuel Moisture	8.0 %
Live Woody Moisture	75%-FM5 / 150%-FM10
Midflame Windspeed, Mi./Hr.	2.0 / 4.0 / 6.0
Terrain Slope %	25 / 50 / 75
Direction of Wind Vector	clockwise from uphill

The table below models the fire behavior outputs of the existing condition, based on inputs described above. The resulting outputs Flame Length (FL), Rate of Spread (ROS), and Estimated Fire Size given a 2-Hr Time Lapse. Post-treatment outputs are modelled separately in the Effects section of this report.

Table 4: Pre-treatment Rate of Spread, Flame Length, and Elapsed Time Outputs from Behave Model for FM5 and FM10

OUTPUT	FUEL MODEL 5				FUEL MODEL 10			
Rate of Spread (chains/hr.)	Midflame Wind	Terrain Slope %			Midflame Wind	Terrain Slope %		
		25%	50%	75%		25%	50%	75%
	2.0 mph	13	21	36	2.0 mph	3	5	8
	4.0 mph	26	35	50	4.0 mph	5	7	11
	6.0 mph	43	52	66	6.0 mph	9	11	14
Flame Length (ft.)	Midflame Wind	Terrain Slope %			Midflame Wind	Terrain Slope %		
		25%	50%	75%		25%	50%	75%
	2.0 mph	4.7	5.9	7.5	2.0 mph	3.0	3.9	4.9
	4.0 mph	6.5	7.4	8.7	4.0 mph	4.1	4.7	5.6
	6.0 mph	8.2	8.9	10.0	6.0 mph	5.1	5.6	6.3
Estimated Fire Size given 2-hr lapse (acres)	Midflame Wind	Terrain Slope %			Midflame Wind	Terrain Slope %		
		25%	50%	75%		25%	50%	75%
	2.0 mph	40	87	188	2.0 mph	1.9	4.1	8.9
	4.0 mph	119	182	302	4.0 mph	5.0	7.9	13.5
	6.0 mph	246	323	461	6.0 mph	10.0	13.5	19.9

Fire behavior predictions for current fuel conditions, pre-treatment indicate that ROS could be up to ¾ mile per hour in FM 5 areas, and up to 2/10ths mile per hour in FM10. FL in FM5 would exceed handcrew capability all of the time. FL in FM10 would exceed direct attack by handcrew capability over 78% of the time. Potential for large fire growth based on fire behavior characteristics of ROS and FL exists, especially in FM5.

Post-treatment

The table below displays the outputs from BEHAVE to model potential fire behavior based on stand conditions following implementation of the proposed action, including Fuel Models 5 and 8.

Table 5: Proposed Action Rate of Spread, Flame Length, and Estimated Fire Size Outputs from Behave for FM5

	FM 5				**FM 8**			
Rate of Spread (chains/hr.)	Midflame Wind	Terrain Slope %			Midflame Wind	Terrain Slope %		
		25%	50%	75%		25%	50%	75%
	2.0 mph	3	5	8	2.0 mph	1	2	3
	4.0 mph	6	8	11	4.0 mph	2	2	3
	6.0 mph	9	11	14	6.0 mph	3	3	4
Flame Length (ft.)	Midflame Wind	Terrain Slope %			Midflame Wind	Terrain Slope %		
		25%	50%	75%		25%	50%	75%
	2.0 mph	1.4	1.8	2.3	2.0 mph	.8	1.0	1.2
	4.0 mph	2.0	2.3	2.7	4.0 mph	1.0	1.2	1.4
	6.0 mph	2.5	2.7	3.1	6.0 mph	1.3	1.4	1.6

and FM10

Estimated Fire Size given 2-hr lapse (acres)	Midflame Wind	Terrain Slope %			Midflame Wind	Terrain Slope %		
		25%	50%	75%		25%	50%	75%
	2.0 mph	1.8	4.1	8.8	2.0 mph	.2	.4	.9
	4.0 mph	5.5	8.5	14.1	4.0 mph	.5	.8	1.4
	6.0 mph	11.5	15.0	21.5	6.0 mph	1.0	1.4	2.1

Post treatment predictions of fire behavior indicate that treatments will be very effective at reducing ROS to a minimum and FL to where all fires can be suppressed by hand using direct attack tactics. Potential for large fire growth has also been shown to be drastically reduced.

The proposed action will cause a beneficial impact to the condition of the fuels within the project area. Stands in poor health and condition will be harvested and resulting fuels treated. Fuels treated within non-commercial treatment units will be treated, increasing their resiliency to a fire occurring within the project. The successful implementation of the proposed action will trend the area towards a low departure from its historic fire regime. Effective treatment of fuels within Wildland Urban Interface designated lands by two different County Wildfire Protection Plans (Latah and Benewah) will have been achieved. Additionally, the suppression responsibility for wildfires within the project area are handled with the Idaho Department of Lands (IDL). The portion of the project area within the Carscallen and Meadow Creek drainages is covered by the Ponderosa Unit based out of Deary, Idaho. The portion of the project area within the Hangman Creek drainage is covered by the West Saint Joe Unit out of St. Maries, Idaho. Protection of Forest Service lands by the State is through an off-set protection agreement. The Idaho Department of Lands provides the suppression on Portions of the Palouse Ranger District where the Forest Service provides suppression protection on IDL lands in different areas of Idaho. As a result of the proposed action, effects include reduced potential fire behavior, facilitated fire suppression activities, and increased likelihood of suppression success within and adjacent to county-identified Wildland-Urban Interface (WUI) areas.

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